Dyspnea-12 Is a Valid and Reliable Measure of Breathlessness in Patients With Interstitial Lung Disease

Janelle Yorke, PhD; Jeffrey Swigris, DO, MS; Anne-Marie Russell, MSc;
Shakeeb H. Moosavi, PhD; Georges Ng Man Kwong, MD; Mark Longshaw, MD ;
and Paul W. Jones, PhD

e-Appendix 1.

Dyspnoea-12 is a valid and reliable measure of breathlessness in patients with ILD

J Yorke, J Swigris, AM Russell, G Man Kwong, M Longshaw, SH Moosavi, PW Jones

Methods

Confirmatory factor analysis (CFA). CFA is used to verify the factor structure (i.e., to examine the relationship hypothesized to exist between observed variables and their underlying latent constructs—in the case of the current study, the latent constructs would be the physical and affective perceptions of dyspnea—of a set of observed variables.[1] In contrast to exploratory factor analysis (EFA)—a process of "orderly simplification of interrelated measures" in which there is no preconceived or hypothesized structure of how the variables relate—in CFA, a researcher will use their knowledge and perhaps results from previously conducted empirical research to test a specific hypothesis about the factor structure of the variables.[1] Thus, CFA requires an *a priori* specification of the model, and the analysis tests how well the data fit this model. It is recommended that 5-20 cases per variable (i.e., questionairre item) be used to perform a CFA.

Unlike traditional statistical techniques, for CFA a battery of tests are used to determine the adequacy of model fit to the data. Results may be discordant, but fit is considered acceptable if the majority of tests support adequate fit to the model. The statistics that are often used to determine model fit with CFA include the following: 1) chi-square—assesses the difference between observed and expected covariance matrices, and values close to zero indicate acceptable fit; 2) the Comparative Fit Index (CFI) is the same as the discrepancy function adjusted for sample size, and larger values (closer to one and ≥ 0.90) indicate acceptable fit; 3) Root Mean Square Error of Approximation (RMSEA) relates to the residual of the model, and smaller values (close to zero and < 0.06) indicate acceptable fit; 4) Bentler and Bonnett's Normed Fit Index (NFI)[2] tests the null hypothesis that the model is one in which all of the correlations or covariances are zero, and values ≥ 0.90 indicate acceptable fit; and 5) Bentler and Bonnett's Non-normed index (NNI) touted to better reflect fit at all sample sizes, with values ≥ 0.90 indicating acceptable fit.[2]

We used PROC CALIS in SAS version 9.1.3 (SAS Inc., Cary, NC) to test the hypothesized two-factor structure (items 1-7 would load on a factor describing the latent variable "physical perceptions of dyspnea," and items 8-12 would load on a factor decscribing the latent variable "affective perceptions of dyspnea") of the D-12.

Results

A. Manifest Variable Equations with Estimates. Parameter estimates for the confirmatory factor model are significant at the 0.01 level if the t value exceeds 2.56.

```
item1  =  0.7119*F1      +  1.0000 e1
Std Err    0.0878 p1
t Value    8.1049

 item2  =  0.8869*F1      +  1.0000 e2
Std Err    0.0788 p2
t Value    11.2613
```

```
item3  =  0.8899*F1    +  1.0000 e3
Std Err    0.0786 p3
t Value    11.3254


 item4  =  0.8891*F1     +  1.0000 e4
Std Err    0.0786 p4
t Value    11.3079


item5  =  0.8996*F1    +  1.0000 e5
Std Err    0.0780 p5
t Value    11.5364


item6  =  0.8546*F1    +  1.0000 e6
Std Err    0.0807 p6
t Value    10.5953


item7  =  0.4528*F1    +  1.0000 e7
Std Err    0.0967 p7
t Value    4.6812


item8  =  0.8726*F2    +  1.0000 e8
Std Err    0.0797 p8
t Value    10.9524


item9  =  0.9102*F2    +  1.0000 e9
Std Err    0.0774 p9
t Value    11.7608


item10  =  0.8721*F2    +  1.0000 e10
Std Err    0.0797 p10
t Value    10.9411


item11  =  0.8746*F2    +  1.0000 e11
Std Err    0.0796 p11
t Value    10.9933


item12  =  0.8953*F2    +  1.0000 e12
Std Err    0.0783 p12
t Value    11.4329
```

B. Variances of Exogenous Variables

Variable	Parameter	Standard Estimate	Error	t Value
F1		1.00000		
F2		1.00000		
e1	vare1	0.49318	0.07328	6.73
e2	vare2	0.21337	0.03659	5.83
e3	vare3	0.20804	0.03593	5.79
e4	vare4	0.20950	0.03611	5.80
e5	vare5	0.19064	0.03379	5.64
e6	vare6	0.26968	0.04375	6.16
e7	vare7	0.79502	0.11381	6.99
e8	vare8	0.23854	0.04014	5.94
e9	vare9	0.17153	0.03203	5.36
e10	vare10	0.23949	0.04026	5.95
e11	vare11	0.23508	0.03970	5.92
e12	vare12	0.19840	0.03519	5.64

Variances are all significant at the 0.01 level.

C. Covariances Among Exogenous Variables

Var1	Var2	Parameter	Standard Estimate	Error	t Value
F1	F2	covf1f2	0.83007	0.03669	22.62

Covariance between latent constructs is significant at the 0.01 level.

D. Correlations Among Exogenous Variables

Var1	Var2	Parameter	Estimate
F1	F2	covf1f2	0.83007

As expected, correlation between latent constructs (i.e., Physical and Affective components of dyspnea) is high at the 0.8 level.

References

1.	Suhr D. Exploratory or Confirmatory Factor Analysis? *SAS Usuers Group International Conference* Vol 31. San Francisco: SAS User's Group; 2006:Paper #200
2.	Bentler PM. Comparative fit indexes in structural models. *Psychol Bull.* Mar 1990;107(2):238-246.